

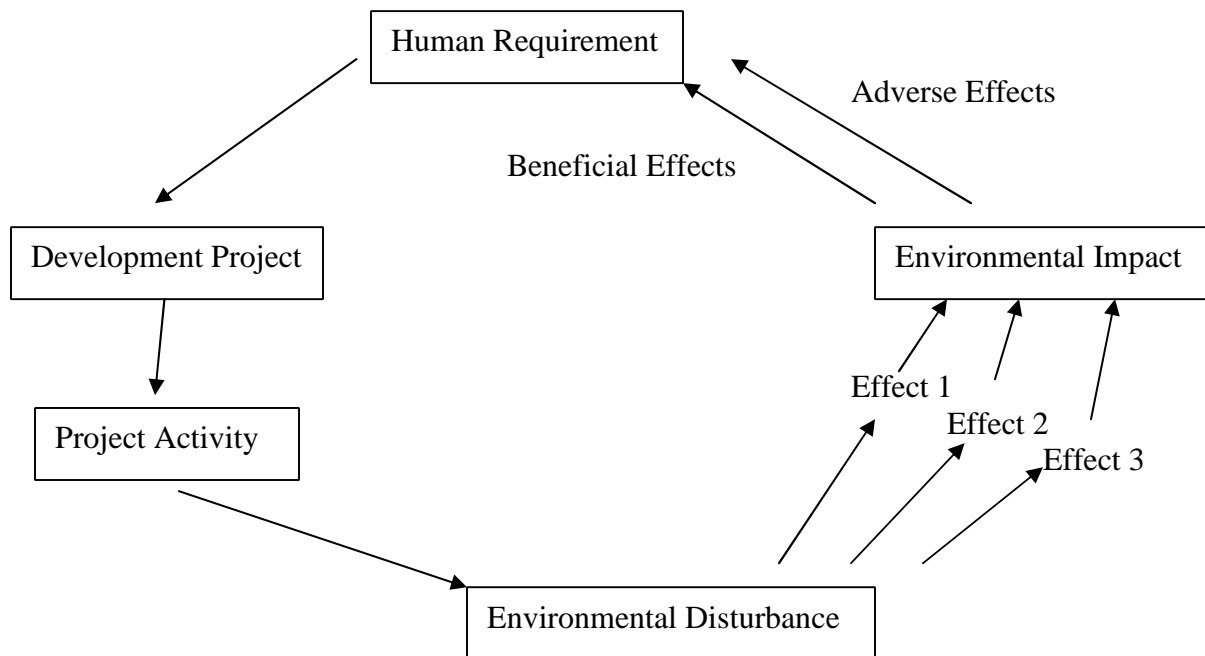
## Chapter 10

### 10.0 Environmental Impacts of Proposed Development

#### 10.1 General Principles Underpinning Environmental Impacts

In principle the need to address some requirement(s) of the human species gives rise to the definition and implementation of some specific development project(s) or programme(s). In the context of the proposed development, the human requirement to be addressed is the need for leisure and recreation.

Inherent in development projects and programmes are activities which alter the environment, or causes some “environmental disturbance”. These environmental disturbances have a number of “effects” which in turn leads to “environmental impacts”, which are categorized as being either negative or positive. This impact cycle is summarized in Fig. 10.1.



**Fig. 10.1:** Environmental Impact Cycle

Environmental impacts are in principle hierarchal and in this regard are described as being sequentially ‘primary’, ‘secondary’, ‘tertiary’ in orientation. An example of this impact sequence which specifically relates to the currently proposed project is shown in Table 10.1. Primary impacts are those impacts arising immediately from particular development activities such as dredging and land reclamation, and affect basic ecosystem functions such as primary productivity, mechanical damage to anatomical structures and the physical destruction of

habitats. Parameters relevant in regards to these ecosystem functions are; suspended solids, turbidity, macro-nutrients, and dissolved oxygen [See Table 10.1].

The ‘primary impact’ parameters in turn have another level of impacts on various ecosystem components, which are qualified by both magnitude and direction. This is unlike the ‘primary impacts’, which within the context of the current EIA varies in magnitude only [See EIA Matrix outlined in Table 10.1]. In the case of primary or “Level 1” impacts, this may be explained by the fact that variations in the magnitude of these parameters, in and of themselves, are neither deleterious nor beneficial. Thus an increase in dissolved oxygen, macro-nutrients, or turbidity are neither positive nor negative, until and/or unless they in turn affect some other ecosystem component(s). This is in principle the secondary or “level 2” impacts. The consequence of increased nutrients on sea-grass productivity and cover in the nearshore areas of the caye should be beneficial – thus within the context of the EIA Matrix outlined in Table 10.1, this impact is ascribed a positive value, i.e. it is beneficial. Conversely the impacts of sedimentation on these sea-grass meadows is deleterious and is consequently ascribed a negative value, which signifies a ‘deleterious’ impact.

Primary or level ‘1’ impacts may also have an effect on ‘higher order’ activities, which are usually human systems or human development activities. These are generally referred to as ‘tertiary’ or ‘level 3’ impacts. Thus within the context of the currently proposed project, an increase in sedimentation associated with dredging activities could have a deleterious or negative impact on seagrass productivity and macro-invertebrate populations around the caye: These are referred to as ‘level 2’ impacts [See Table 10.1]. The increase in sedimentation may also have negative consequences on fishing activities. The poor visibility conditions of the water column would likely impede the ability of lobster and conch divers to locate and capture their catches. The direct effect of the development on fishing is in principle a “level 3” impact, which in this case is a deleterious impact [See Table 10.1].

Under the current analytical process outlined in the EIA Matrix [See Table 10.1], although a relationship may exist, the magnitude of change of the particular parameter may be so small or insignificant, that no discernible impact is identified; in such circumstances the event is assigned a score of “0”.

## **10.2 Overview of Environmental Impacts**

The level of adverse, or alternatively, beneficial impacts on the environment is a function of the nature and magnitude of the particular development activity, and the capacity of the receiving environment to assimilate and/or respond to these impacts.

The connectivity or hierarchal nature of the impacts of the proposed project has been underscored by the integration of a color scheme in the EIA Matrix outlined in Table 10.1. The vertical commonality of a particular color in the matrix has been done to underscore the cascade of the impacts of a particular parameter at the primary, secondary and tertiary levels of the system.

The primary activities that are likely to give rise to significant environmental impacts are the dredging and reclamation activities, the generation of domestic effluents and solid wastes, as well as the land-clearing issues and in general physical alteration of terrestrial and aquatic habitats [See Table 10.1].

Apart from the 'ecological oriented' environmental impacts, the socio-economic impacts are also highly relevant. These relate to the impacts of the proposed development on pre-existent or planned economic activities in the area such as tourism, fishing and marine traffic.

### **10.3 Details of Environmental Impacts**

#### **10.3.1 Dredging Impacts**

The most notable primary aquatic impacts arising from the dredging operations are expected to be an increase in sedimentation and turbidity, as well as an increase in BOD and Hydrogen Sulphide [See Table 10.1].

The magnitude of the turbidity and sedimentation impacts associated with the dredging activity is a function of the scope of the activity and the consistency of the material to be dredged.

The dredging method to be applied utilizes a 'Cutter Head' Dredge. The excavated material, which is to be calcareous mud and coarse coralline sand is to be pumped from the burrow pits or excavation sites to the Caye: It will then be deposited within a retaining wall of rip-rap lined by a fine-meshed geo-textile polymer. This will allow for the de-watering of the dredged spoils, while constraining the return of highly turbid outflows to the surrounding seas.

The turbidity and sedimentation influences are to be associated with the burrow pits, as well as the spoil discharge pipes and return flows from the retaining walls. It is expected that the net flow of the turbidity plume will be towards the south and east, which is coincident with net current movement in the area. This is in the direction of the open sea and the Placencia Peninsula.

The primary sedimentation and turbidity impacts have been assessed as '3' or 'major' at their most extreme [See Table 10.1]. This is a function of the macroscopic scope of the undertaking; in this regard 350,863 M<sup>3</sup>. The secondary or 'level 2' impacts at their most severe has been assessed at '-2' or 'moderately adverse'. This is a function of the deployment of sediment curtains to accompany the burrowing operation and in effect corral or 'contain' the sediments.

The assessment of the secondary sedimentation and turbidity impacts as 'moderate' at their most severe is also a function of the ecological status and sensitivity of the 'receiving environment' [Pers. comm., G. Myvett]. Although there is some reef building or stony corals in the area, these occur largely as isolated coral heads as opposed to being assembled in massive bio-ramparts or reef systems. Much of the corals in the area are degraded, perhaps as a function of the reported sustained turbid nature of the area.

The geographic area to be most affected by sedimentation and turbidity influences is the locale immediately around the Caye, which has been described as the ‘Nearshore Ecosystem 0.5 mile around False Caye’ [See Table 10.1]. Apart from the ‘moderate’ impacts mentioned above, most of the impacts to the areas have been assessed either as ‘-1’ or ‘minor adverse’, or ‘0’ or ‘a relationship exists but impact is expected’ [See Table 10.1].

The areas geographically removed from the dredging and reclamation activities are not expected to be significantly affected by the ‘secondary’ turbidity and sedimentation impacts. This includes the Placencia Peninsula and the offshore ecosystem or open sea [See Table 10.1].

The tertiary sedimentation and turbidity impacts are mainly in the ‘minor adverse’ category [See Table 10.1]. These impacts relate to ‘economic’ and ‘human settlement’ issues. These relate to fishing activities and ‘odor’ and ‘muds and sight pollution’ [See Table 10.1].

### **10.3.2 Land Reclamation Impacts**

The land reclamation activities relate to changing the landform of the caye from a swampy and mucky inundated area to a consolidated area largely of carbonate sand and excavated marl. The caye will be reclaimed to an elevation of 5 ft. above MSL [mean sea level]. Apart from the aforementioned ‘sedimentation’ and ‘turbidity’ impacts, the most notable impacts associated with the reclamation scheme are a ‘decrease or elimination of roosting habitat’, an ‘elimination or loss of mangrove prop root habitat’ and a ‘decrease in coral cover and diversity’ [See red and yellow color scheme Table 10.1].

The elimination of the roosting habitat affects a number of seabirds and wetland birds such as the Neo-Tropical Cormorant (*Phalacrocorax brasilianus*), the Brown Pelican (*Pelicanus occidentalis*) and the Little Blue Heron (*Egretta caerulea*).

The moderate extent of the secondary impacts were mainly a function of the deployment of sediment curtains at the burrow site and along the path of the spoil discharge pipes, as well as the placement of the retaining walls on the caye to contain the spoils.

The moderate adverse impacts ascribed to the prop roots and mangrove canopy are mainly as a function of the placement of the retaining rip-rap walls within or landward of the circumnavigating zone of mangrove describing the outer perimeter of the caye.

The tertiary impacts of the loss of nursery function and prop root habitat have also been ‘non-existent’ to ‘minor’ [See Table 10.1]. This is mainly a function of the paucity of commercial fishstocks around the caye and the limited fishing effort associated with this.

The lack of any discernible impacts on the Placencia Peninsula [See Table 10.1] is a function of geographic distance: The Peninsula is roughly a mile away from the caye at its nearest approaches, which places it beyond the reach of the ecological impacts of the development.



### 10.3.3 Domestic Effluent Impacts

The two (2) main impacts relevant to the proposed undertaking are increased nutrients and fecal coliform in the water column.

The situation of increased nutrients in the water column is generally referred to as eutrophication. This relates to the macro-nutrients, which are 'phosphates' and 'nitrates'. These are generally derived from gray water effluents, as well as sewage effluents from the flushing of toilets.

In general a major source of macro-nutrients in gray water effluents is from detergents. This is also relevant to the proposed development. Another source of macro-nutrients, within the context of the proposed project, would be from the mechanical disturbance of the sea bed. The latter is associated with the dredging operation. The excavation and in part liberation of fine sediments that is associated with the dredging operation would also result in the dissolution of nitrates and phosphates in the water column.

The secondary impacts of macronutrients would be most relevant to the waters immediately around False Caye [See Table 10.1]. This has been assessed at its most extreme as '+1' or 'minor beneficial' for all the parameters impacted, except for the 'coral cover and diversity' category which has been assessed as '-1' or 'minor deleterious' [See Table 10.1].

In general the 'minor' categorization of the secondary impacts is a function of the judicious management of the effluents associated with the proposed development. This entails the deployment of sewage treatment technology which incorporates a water recycling scheme with very limited discharge of effluents for irrigation and fire fighting purposes [See Chap. 1].

The sewage technology to be applied is secondary treatment with the reduction of nutrients to levels that are not a threat to the environment and that are well within national standards. The system to be adopted for the proposed project is a prefabricated treatment plant or 'Package Plant' titled a "Purestream ES Model BESST" [See Chap. 5]. The acronym of the systems stands for **B**iological **E**ngineered **S**ingle **S**ludge **T**reatment.

The BESST Plant can reduce the Biological Oxygen Demand and Total Suspended Solids by 97% to less than 10 mg/L [See Annex IV]. Total Nitrogen Loads can be reduced by 67% to less than 10 mg/L and Total Free Ammonia Loading can be reduced by 97.5% to less than 1 mg/L [See Annex IV].

Phosphorus can be reduced by 80% by the BESST System to 2 – 3 mg/L [See Annex IV].

The issue of fecal coliform associated with the development is an important one. As may be seen from the Feb – April 2007 Tunich Nah Field Survey, there were no detectable levels of Total Coliform or *E. coli* [See Annex V].

The generation of *E. coli* becomes a significant consideration with the commissioning of the False Caye operation. The primary impact from these features of the development has been characterized as ‘major’. The application of the BESST Sewage Treatment Technology combined with water conservation measures vis-à-vis the water recirculation/reuse scheme dampens and greatly diminishes the potential human health impacts from fecal coliform. Thus the ‘Tertiary Impact’ for the potential of ‘Pathogenic Diseases’ has been assessed as ‘-1’ or minor adverse [See light blue color scheme Table 10.1].

#### **10.3.4 Potable Water Impacts**

One of the potential threats of the sourcing of potable water is the salinization of soils and restricted waterways from the application of ‘desalination’ technology. Although the primary source of potable water should be from ground-water stores, this should be supplemented by the desalinization of surface sea-water. The draw-down on sub-surface freshwater cells may also result in saline intrusion if the demand exceeds the sustainable yield of the source. These two contributors have negative implications for the salinization of soils.

The deposition and dewatering of dredged spoils is also another major source of salinization of soils. This impact is expected to dissipate with time after the construction phase of the project.

The salinization of soil is expected to range from moderate to major in scope in terms of primary impacts. This is driven by the scope of the reclamation scheme in terms of the major impact source, and the potable water technology to be deployed in regards to the ‘moderate’ categorization [See Table 10.1].

Much of the ‘secondary’ or ‘level 2’ have been characterized as ‘moderate’ in scope [See Table 10.1]. The ‘deleterious’ orientation is relevant mainly to the environmental stress that the caye-based mangroves will be exposed to in relation to the reclamation scheme. This impacts the prop root systems of the fringing mangroves as well as the canopy biomass [See Table 10.1].

The ‘tertiary’ impacts associated with the salinization of soils have been characterized as ‘minor deleterious’ [See Table 10.1]. Much of these impacts are in relation to aesthetic issues [See Table 10.1].

#### **10.3.5 Solid Waste Impacts**

The generation of solid waste relates to both the construction and operational phases of the proposed project. The construction phase activities with the capacity to generate substantial volumes of solid wastes include the construction of both the shore-based lodging and recreational infrastructure, as well as the piers in the nearshore seas and

lagoonal systems [See Chap. 1, Fig. 1.2]. These wastes range from packaging materials to concrete form works, sheared metal and PVC scraps, as well as masonry slabs and chippings. Food wrappings, cans and beverage cartons and plastic and glass bottles are also expected to be a substantial part of the solid waste portfolio. Discarded food is also a relevant solid waste item during the construction phase.

The greatest contributor in terms of the volume of waste generated is expected to be packaging materials: This is expected to be in the form of wooden crates, carton boxes, styrofoam boxes, and insulation foam mats and slabs.

During the operational phase of the project the solid waste constituent is expected to span a wide range of possibilities, encompassing food discards, plastics, paper, glass, metals, rubber and wood. The food discard component is expected to increase by orders of magnitude given the relatively large numbers of clientele. Most of the other solid waste components are also expected to increase, especially plastics, paper and glass.

The proposed management scheme for solid waste at False Caye involves a collection site, a sorting area to separate the biodegradable from the non-biodegradable, and the combustibles from the non-combustibles. The biodegradable components are to be composted on site and used as mulch and organic fertilizer for gardens and hedge rows. The non-biodegradables are to be collected and stored on the caye until sufficient volumes have accumulated to warrant transportation off-site to the Placencia Municipal Dump Site. It is expected that this will be done once or twice per week.

The two (2) main environmental issues related to the generation and management of solid waste are the potential for the attraction of feral animals to the site and the potential for increasing the incidence of nuisance insects and pathogenic diseases. The attraction of feral animals to the main development sites would be as a consequence of the increased availability of food in the form of discards from the restaurants and refreshment stands. The animals relevant in this regard would be mainly rats inadvertently introduced to the site, crocodiles (*Crocodylus acutus*) and vagrant and opportunistic birds such as the Grackle (*Quiscalus mexicanus*), the Herring Gull (*Larus argentatus*) and the Frigate Bird (*Fregata magnificens*).

The only secondary impacts of note are in regards to the crocodiles and sea birds. These impacts have both been assessed in the 'minor beneficial' category. The 'minor' element of the designation relates to the fact that there will be little or no discarded food lying around in a way that would be available to feral animals given the regular collection, composting and disposal of this category of waste.

The 'beneficial' aspect of the secondary impact designation would relate to the potential fattening aspect and proliferation of the species from the consumption of food discards. Although there has been no specific census of crocodiles or scavenging birds in the area, it can be discerned that any incremental increase in the availability of food would bode well for the population status of the species.

The tertiary impacts in regards to solid wastes have also been assessed as ‘minor’; the ‘adverse’ categorization of these impacts relate to the threat of pathogenic diseases and injury from potential encounters between the guests or staff and scavenging crocodiles and birds. Aesthetic impacts are also an issue of relevance. This has been assessed as ‘minor adverse’ [See Table 10.1]. Again, the ‘minor’ categorization of these impacts is related to the judicious management of solid wastes that are a part of the response of the False Caye Enterprises Ltd Management Structure.

### **10.3.6 Pier and Boating Impacts**

The main ‘primary impact’ associated with the construction of the main pier, the service dock and other associated standing platforms in the sea and various internal lagoons [See Fig. 1.2] is the accumulation of solid wastes [See Table 10.1]. This impact however has been assessed as ‘minor’ in scope [See Table 10.1]. The other primary impact of piers and docks is that they form an artificial habitat for attached benthic flora and fauna. This primary impact had been assessed as ‘moderate’.

The secondary impact of note associated with the main pier is petroleum pollution associated with the dispensing of fuel and general navigation within the area by motorized crafts. Another potential source of petroleum pollution would be from the unauthorized and inappropriate discharge of ‘bilgewater’ in the area.

The secondary impact of petroleum pollution have been categorized as ‘minor deleterious’ [See Table 10.1] given the fact that no fuel is to be stored or dispensed on the Caye.

The tertiary level impacts associated with petroleum pollution have also been assessed as ‘indiscernible’ [See Table 10.1].

The other secondary impact ascribed to piers has been in relation to their habitat value. This impact has been assessed as ‘moderate’ at its most significant. This ‘moderate beneficial’ has been ascribed to attached invertebrates. These in turn form habitat and food for vertebrate fish, the impact of which has been assessed as ‘minor beneficial’ [See Table 10.1].

The tertiary level impact of note in relation to piers and docks is fishing; this has been assessed as ‘minor beneficial’ [See Table 10.1]. The ‘minor’ categorization has been based on the fact that only a small proportion of the fishes that are a part of the pier and dock food chain are taken for commercial and sport fishery purposes.

### **10.3.7 Impacts from Energy Generation**

The two (2) main impacts associated with energy generation are petroleum pollution and noise pollution. The decision not to store or dispense any fuel on the caye in relation to boating operation greatly reduced the potential for petroleum pollution. The only fuel

that will be stored on the caye is in relation to the standby generators. It is envisioned that roughly 100 gals of diesel will be stored at any one point in time for the backup generators

The noise pollution issue is of greater relevance than the petroleum pollution issue, in regard to energy generation. The installation of diesel generators as a back-up source of electricity makes noise pollution a relevant issue. The scope of the proposed development and indeed the overall energy requirement of the initiative have resulted in a categorization of the 'primary impacts' as '-2' or 'moderate adverse' [See Table 10.1]. The 'tertiary impacts' have been assessed as '-1' or 'minor adverse' [See Table 10.1], given the 'muffling' of these generators and the use of sound-proof tiles in the generator stations [See Chap. 7], as well as their placement in the 'utility zone', where they are removed from recreational activities of the guests and staff of the facilities. [See Fig. 2.1].

#### **10.4 Social and Economic Impacts**

The development is classified as a both a "Residential" and "Resort" for people from North America, Europe and Belize. The potential positive impacts identified by villagers on the proposed development are:

- increased employment and job creation and the possibility for some villagers to enter or expand their business, such as handicraft marketing at the boutiques or shops to be established in the resort;
- a general sentiment by village leaders is that they hope the developer does "the right thing" since he has the financial resources to do so; and
- a general increase in business activity and revenue generation during the construction and post-construction phase of the development.

Other indirect benefits may be for existing tourism businesses that will cater to an increased retiree population and who may also specialize in tourism-related catering and related service businesses to this population.

The main **negative** concerns, in no order of priority, are:

- long term access to traditional fishers to the fishing grounds for lobster, crab and scale fish;
- senior management jobs in these resorts are reserved for outsiders while the local people are employed for the menial jobs only;
- supply of potable water to the development may compete with the water supply to Placencia and Seine Bight;
- disposal of solid and sewerage waste in already fragile environment;
- the cutting of mangroves resulting in breeding grounds loss and lack of protection from storms;
- dredging impact on the corals of the area and on beach erosion;
- where the source of fill material for the island will come from,
- beach erosion on the east side of the peninsula affecting properties; and
- possible destruction of the beautiful snorkeling grounds.

The other potential negative impact on local and regional tourism sector is the competition with Belizeans of the area that may arise should the retirees become investors and compete with locals. One of the direct effects of such competition is the possible increase in the price of land.

The impacts of the development on the general socio-economic conditions of the area can be as follows:

- a. Communities in the area would benefit from the retiree community who may contribute to the social amenities including improvement of village facilities and granting scholarships to high school students, among others;
- b. At the village level, tourism development may increase the crime rate and sexually transmitted diseases as an increasing number of people will come into the project site area seeking employment; and
- c. Migrant labor are already settling permanently in Placencia and Seine Bight thus requiring more house lots, classrooms, health services, more potable water connections, etc. There are no public lands in Maya Beach and Riversdale.